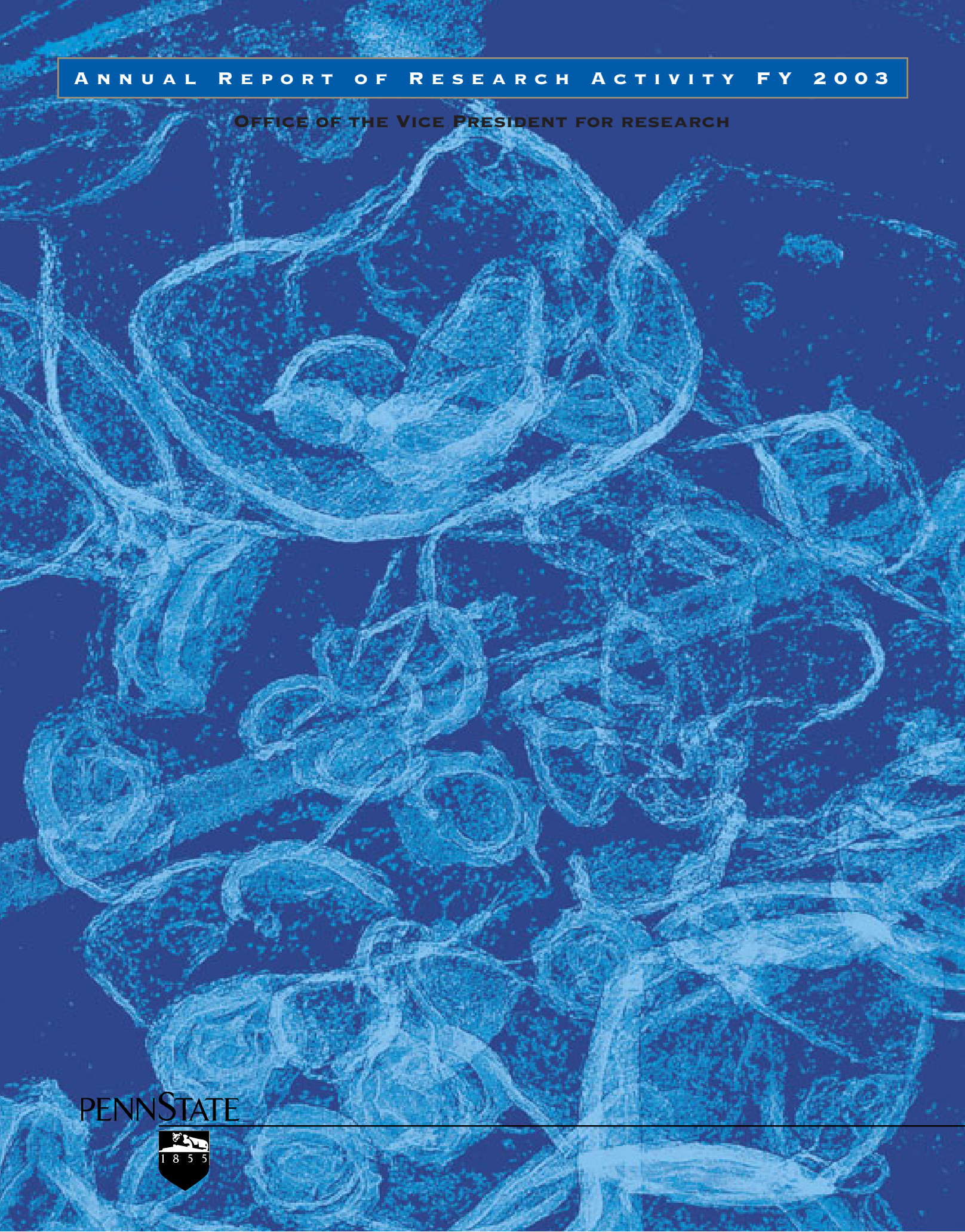
Annual Report of Research Activity FY 2003

Office of the Vice President for research



PENNSTATE

1855

Contents

On the cover:

A color-enhanced transmission electron microscope (TEM) image shows nanocomposite platelets of cadmium sulfide and silicon dioxide, synthesized by self-assembly at Penn State's Particulate Materials Center. See "Nanoparticles," page 9. Courtesy James Adair.

Welcome

When Evan Pugh, the first president of Penn State, arrived in 1859, he immediately established a laboratory.

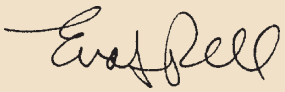
As he wrote, no true teacher "contents himself with merely attending to his classes, and sitting down at ease after he has got them at work. He is studying constantly himself; making original investigations and publishing them to the world." This ethic of study, discovery, and publication has characterized Penn State since its founding and led to the University's recognition as one of the leading research universities in the country.

One dramatic measure of Penn State's success is the continued rapid growth in the University's research expenditures, which in FY 2003 reached a total of $545 million. What the numbers alone cannot show, however, is how all that activity impacts daily life.

The highlights presented in these pages tell some of that story. In the decades of bioengineering and clinical work that allowed a first patient to walk out of the hospital with a fully implantable heart-assist device; the rapid well-coordinated response to an exotic viral pathogen that helped save Pennsylvania's peach industry; the thinking-antenna technology that could revolutionize wireless communication; in these and hundreds of other examples the land-grant mission — bringing cutting-edge research to practical fruition — lives on.

James Collins

Penn State faculty members and their students continue to "make original investigations and publish them to the world" — generating knowledge that serves both Pennsylvania and the nation, and helps in many ways to improve the quality of life for all Americans.



Eva J. Pell, Vice President for Research and Dean of The Graduate School

OVERVIEW

James Collins

The new Life Sciences building at University Park will house Centers of Excellence in plant biology, neurosciences, developmental biology, and toxicology and carcinogenesis.

Over the last 15 years, Penn State has enjoyed tremendous growth in R&D expenditures, on a scale that has placed the University squarely in the ranks of the nation's top research institutions. From a total of $192 million in FY 1988, expenditures have increased 184% to $545 million in FY 2003. According to National Science Foundation data for 2001, the latest year available, Penn State ranked 11th among all U.S. universities in R&D expenditures. An indication of the wide-ranging quality of the University's research program is that in ten of the fields ranked by the NSF, from chemical engineering to sociology, Penn State appeared among the top five institutions.

The funding for research expenditures comes primarily from federal, industry, and foundation sources, and is spent mostly in Pennsylvania, providing an important boost to the state's economy. This year, for the first time, expenditures from federal agencies reached $300 million, with significant increases from several major sources including the National Science Foundation, up 20% to $42 million; the Department of Energy, up 37% to $12.5 million; the Department of Defense, up 9% to $116 million; and the Department of Health and Human Services, up 4.6% to $86 million.

Contemporary research is rarely conducted by single investigators, or even in narrowly defined fields. One of the things that makes Penn State unique is the strength of its interdisciplinary research efforts. Historically, this interdisciplinarity has been clearly evident in the area of materials research. The Materials Research Institute incorporates faculty from the colleges of Earth and Mineral Sciences and Engineering, the Eberly College of Science, and the Applied Research Laboratory into a research program that is ranked first in the nation. The University's other strategic initiatives house large-scale collaborative efforts in the Penn State Institutes of the Environment, the Huck Institutes of the Life Sciences, and the Social Science Research Institute, including the Children, Youth, and Families Consortium. Together, these four interdisciplinary areas accounted for $333 million in research expenditures, over 60% of the University's total expenditures.

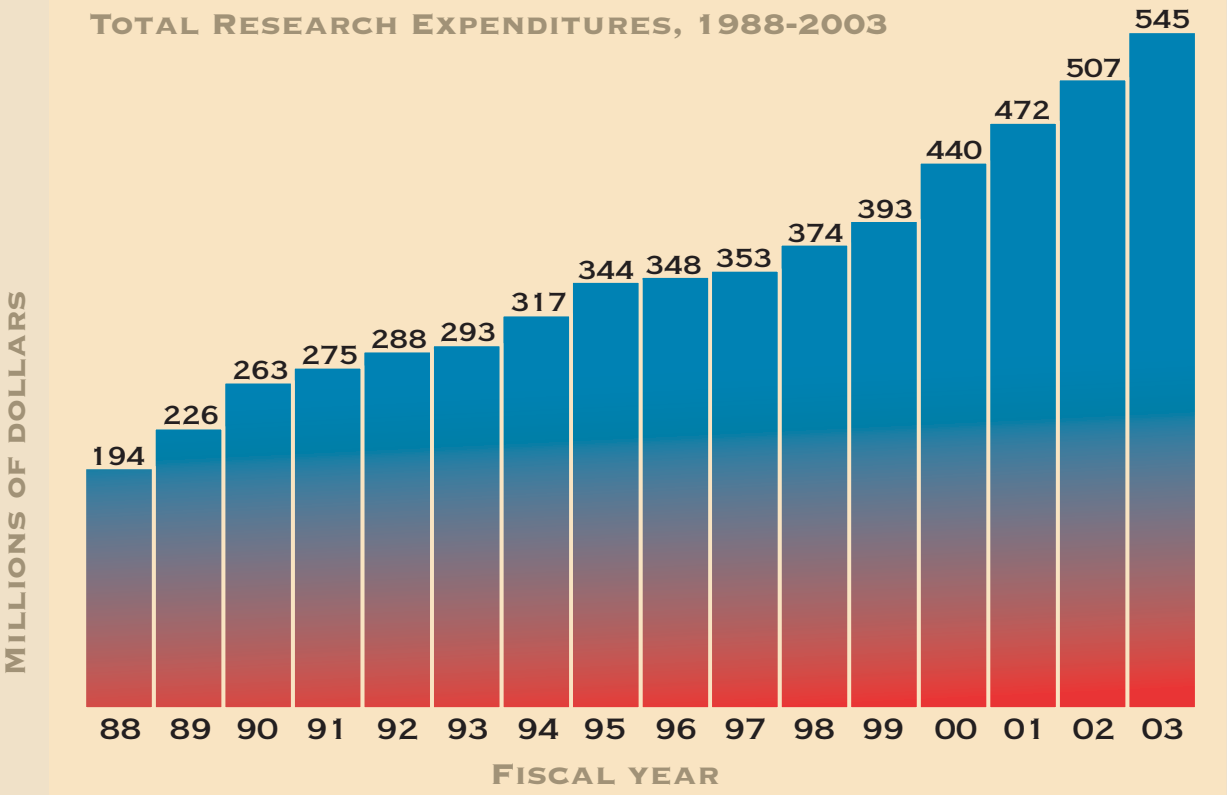
Another historic strength at Penn State, defense-related research, has assumed more importance than ever in the context of an intensified national effort to promote homeland security. The Applied Research Laboratory, established in 1945, is Penn State's largest single research unit, with annual research expenditures in excess of $100 million provided primarily by the U.S. Navy. In addition, in 1999, the Marine Corps Research University was founded at Penn State to support the educational, research, and technical-assessment requirements of the U.S. Marine Corps and the other armed services as they face the technological challenges of the twenty-first century.

Long a leader in industry-sponsored research, Penn State ranks third nationally in this category, behind only Duke and MIT in the 2001 NSF tally. It isn't surprising, then, that the University has made rapid recent gains in the area of intellectual property. According to a study published by MIT's *Technology Review*, Penn State's patent activity increased by 175% between 1997 and 2002, the highest percentage gain of any U.S. university. The increase in patents, coupled with their relevance — measured in the number of times patents are cited — moved Penn State from 31st to 14th in the nation in technological strength.

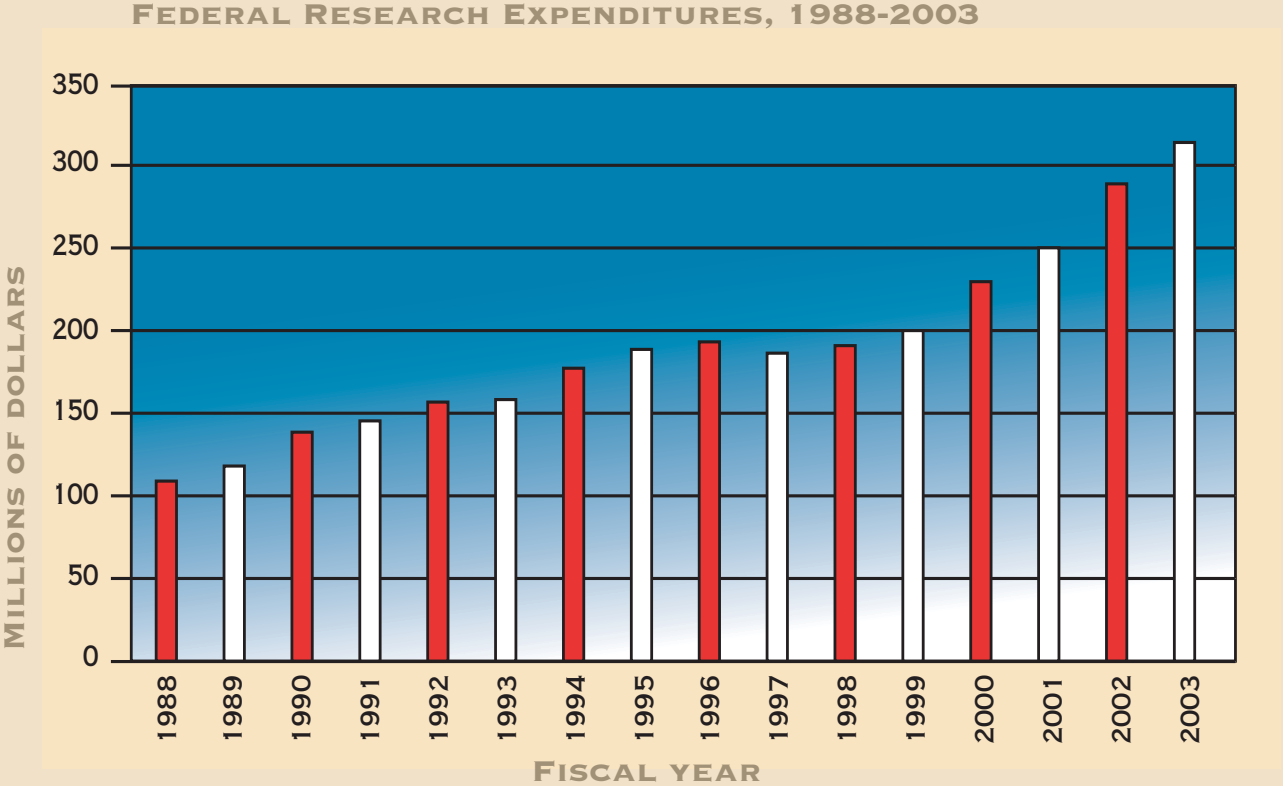
By combining traditional strengths with bold new initiatives, Penn State has positioned itself to lead the way in solving the problems of the twenty-first century.

Statistical Snapshot

Total Research Expenditures, 1988-2003

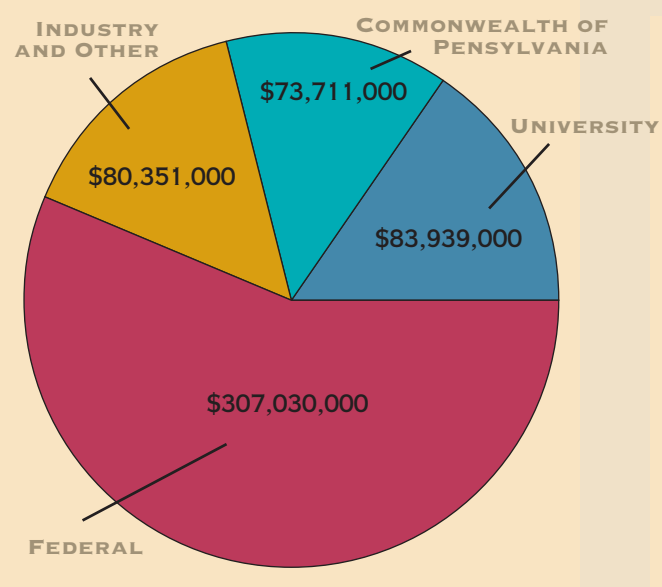


Federal Research Expenditures, 1988-2003



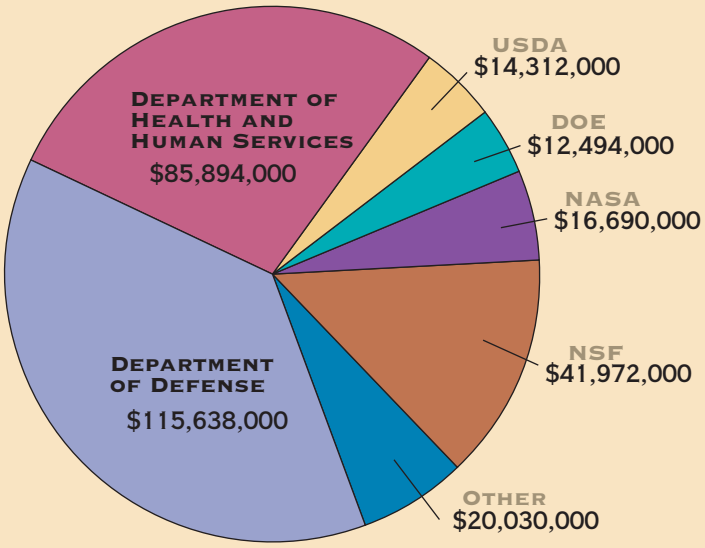
Sources of Research Funding

FY2003 Total - $545,031,000



Expenditures from Federal Agencies

FY2003 Total - $307,030,000

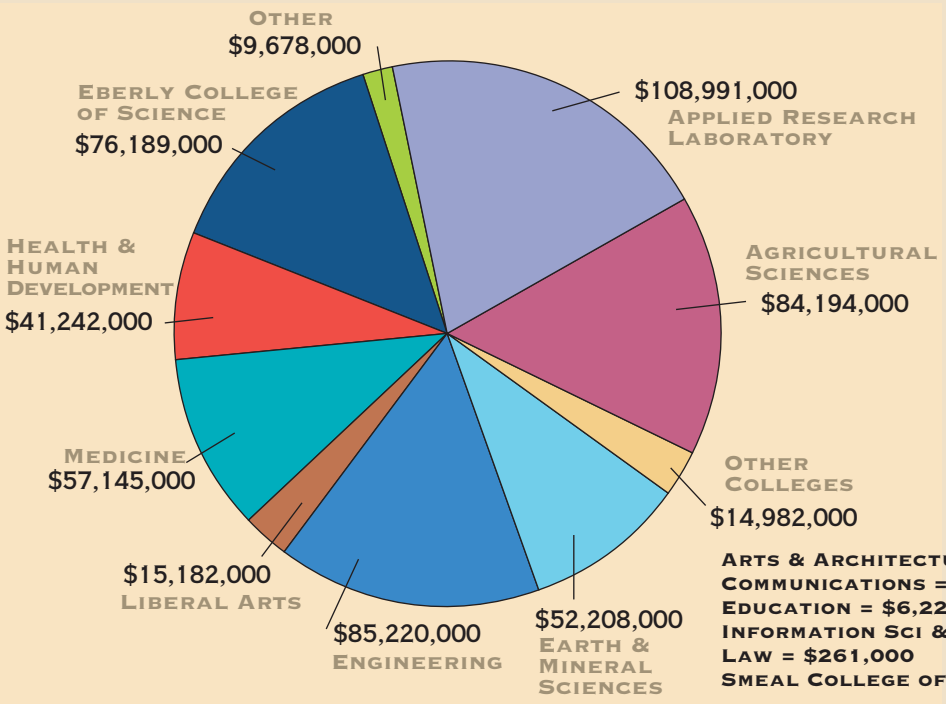


EPA = $3,272,000
Commerce = $898,000
Education = $2,045,000
Interior = $1,254,000
Transportation = $4,922,000
Other Federal = $7,639,000

Research Expenditures by Performing Unit

FY2003 Total - $545,031,000

Altoona College = $406,000
behrend College = $3,185,000
Berks-Lehigh Valley College = $192,000
Capital College = $3,210,000
Commonwealth College = $1,486,000
Penn College = $1,073,000
International programs = $126,000



Arts & Architecture = $920,000
Communications = $93,000
Education = $6,223,000
Information Sci & Tech = $2,508,000
Law = $261,000
Smeal College of Business = $4,977,000

NSF National Rankings for FY2001

1 Johns Hopkins U	$999,246,000
2 U CA Los Angeles	$693,801,000
3 U of WI-Madison	$604,143,000
4 U of Michigan	$600,523,000
5 U of Washington	$589,626,000
6 U CA San Diego	$556,533,000
7 U CA San Fran	$524,975,000
8 Stanford U	$482,906,000
9 U of Penn	$469,852,000
10 U of Minnesota	$462,011,000
11 Penn State	$458,066,000
12 U CA Berkeley	$466,273,000
13 Cornell U	$443,828,000
14 MIT	$435,495,000

Rankings based on NSF Report, “Academic Research and Development Expenditures: Fiscal Year 2001”

TOOLS FOR MANAGING CHANGE

James Collins

Over the next hundred years, global warming is likely to challenge regional ecosystems and economies to adapt to changing climatic conditions. Human and environmental impacts will depend greatly on decisions made at the local level with regard to infrastructure and land-use planning. The Consortium for Atlantic Regional Assessment (CARA) is a multi-university project aimed at helping decisionmakers across the mid-Atlantic region predict the combined impacts of climate change, population growth, land-use patterns, and other factors on their local areas, and then tailor planning and policies accordingly.

Funded by the U.S. Environmental Protection Agency, CARA involves researchers from Penn State, Carnegie Mellon, Rhode Island, and the Virginia Institute of Marine Science working to assess crucial climate-change impacts — on food supply, water quality, recreation and tourism, ecosystems, public health, transportation, and other areas — and to make that information widely accessible through a user-friendly website. The site will contain a regional climate service including current and historical climate data and projections of future climate; information about local and regional land use and land cover; and socio-economic information, such as population density, industry, income levels, and transportation networks. Case studies of selected problems faced in the region's coastal and inland areas will be developed with the help of local stakeholders and presented as decisionmaking tools.

These resources will be highly integrated, so that data on different factors can be combined easily to generate maps and projections for specific locations and instances. Superimposing layers of information using Geographic Information Systems (GIS) will help local leaders visualize the interactions among multiple factors and apply the latest scientific knowledge to the decisions they must make — decisions that will determine the future quality of life in their communities.

To learn more, see http://www.cara.psu.edu/.

A BETTER HEAD START

What's the best way to prepare pre-school children for later success in school?

That question drives a national research initiative announced last December by U.S. Health and Human Services Secretary Tommy Thompson. With HHS funding, investigators at eight institutions around the country will conduct studies over the next five years aimed at making sure children enter kindergarten ready to learn.

James Collins

One of those institutions is Penn State, where distinguished professor of psychology Karen Bierman directs the $5 million Head Start REDI (for Research-Based, Developmentally Informed) project.

In partnership with Head Start programs serving underprivileged children in Blair, Huntingdon, and York counties, Bierman explains, an interdisciplinary team of Penn State researchers from the University Park and York campuses will implement and evaluate an enrichment program based on the latest developmental research and designed to enhance both social-emotional and language-literacy competencies. A sample of 320 children will be followed from age three through the first grade, half of them following a standard Head Start curriculum, and the other half taught according to the REDI program, featuring story-based lessons, specific teaching strategies aimed at developing core skills, and take-home materials for parents.

For the social-emotional curriculum, Bierman notes, "we'll be using a pre-school version of PATHS (Providing Alternative THinking Strategies)," a program developed by Penn State researchers Mark Greenberg and Celene Domitrovich which is designed to facilitate the development of self-control, emotional awareness, and interpersonal problem-solving skills. "Good pre-school teachers teach these things," Bierman acknowledges, "but it's usually done as conflicts emerge. PATHS is a prevention program that teaches children alternatives to acting out." On the language and literacy side, she says, "There's been a lot of research in the last ten years focused on the development of core language skills, including the ability to hear sounds, recognize patterns, and understand and produce sophisticated grammatical structures, like past and future tense. The curriculum we've put together is intended to facilitate a more systematic and intensive exposure to these skills.

"This isn't going to be 'Head Start as you've never seen it,'" Bierman stresses. "We're taking what is already a very strong developmentally based program and enriching it, to see if we can make it even better."

To learn more, see http://csc.la.psu.edu/.

Keystone Summit

Representatives of Pennsylvania's four major research universities gathered at University Park last April to kick off a major initiative aimed at helping the state and the nation strengthen homeland security.

Penn State, the University of Pennsylvania, the University of Pittsburgh, and Carnegie Mellon University have formed the Keystone Alliance, combining their complementary strengths to provide Pennsylvania's response to the U.S. Department of Homeland Security's education and research needs. Building on successful past partnerships in the life sciences, system-on-a-chip technologies, and nanotechnology, the four partners plan to extend collaborations into a range of important areas including biology, biomedicine, agricultural sciences, engineering, information management and security, and public policy.

"Together, we have strengths that no one could bring individually," said Robert McGrath, associate vice president of research and director of strategic and interdisciplinary initiatives at Penn State.

At the Alliance's inaugural summit, keynote speaker Charles McQueary, undersecretary for Science and Technology in the U.S. Department of Homeland Security, spoke of the importance of bridging the gap between the cutting-edge research currently underway at the country's national laboratories and universities and the development of usable technologies by the private sector. Priority areas McQueary mentioned include border and transportation security, emergency preparedness and response, chemical, biological, radiological and nuclear countermeasures, and information analysis and infrastructure protection.

Penn State projects featured at the summit included research into new sensor technologies for detecting and monitoring biotoxins, pathogens, air quality, underwater surveillance, and chemicals; a new type of vehicle barricade, and helmets equipped with noise-limiting sensors for use in emergency rescue; research on improved structural design and materials for blast survivability of buildings, ships, bridges, and other essential infrastructure; and work on protecting water resources, food supplies, and cyberspace security.

Keith Martin, director of Pennsylvania Homeland Security, noted, "Security is not going to be a part of life; it is going to be a way of life for Americans."

To learn more, see https://homeland.psu.edu/.

Gary Settles

Voices of Discovery

The year 2003 marked the bicentennial of one of American history's defining events: the three-year overland expedition of Meriwether Lewis, William Clark and their Corps of Discovery. In celebration, Penn State's University Park campus hosted a major scholarly conference.

From perspectives in history, art history, political science, literature, philosophy, anthropology, education, and the life sciences, "Lewis and Clark: The Unheard Voices," explored the racially and culturally ambivalent elements of the expedition and its aftermath, with special attention to the voices of the Native Americans, African Americans, and others who often go unheard in traditional narratives of the journey.

The event, co-sponsored by the College of Arts and Architecture, the College of Education, the Office of Outreach and Cooperative Extension, and the Institute for the Arts and Humanities, included art installations, library exhibitions, a recital, and the premier performance of *York: The Voice of Freedom*, an opera composed by professor of music Bruce Trinkley, with libretto by Jason Charnesky, a graduate student in English.

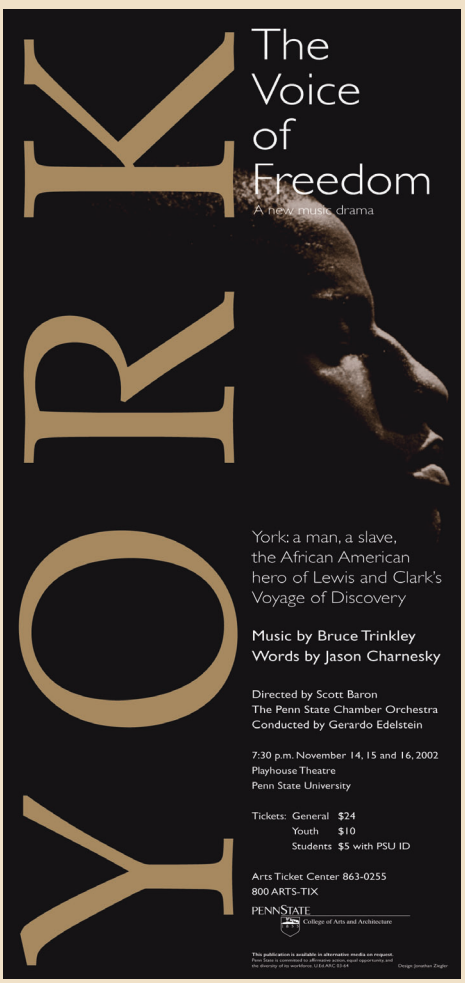
Invited speakers included biologist Daniel Botkin, writer Barry Lopez, artist Jaune Quick-to-See Smith, and Wilma Mankiller, the first female principal chief of the Cherokee nation, who gave the conference's keynote address.

Both the conference and the opera that was its centerpiece grew out of a 1998 cantata that Trinkley and Charnesky had composed about Meriwether Lewis. As they researched that composition, Trinkley and Charnesky realized the richness of the stories surrounding the expedition and became interested in developing a larger musical piece to be presented for the bicentennial, in conjunction with an academic conference.

"We wanted to have a conference that would address important issues and at the same time would reach out both to the University community and to the community at large," Trinkley said.

York: The Voice of Freedom tells the story of William Clark's African-American slave, York, who was treated as an equal member of the Corps of Discovery until the expedition ended, when he was forced back into slavery. The opera was filmed and later broadcast on Penn State's public television station, WPSX.

To learn more, see http://lewisandclark.outreach.psu.edu/.



Jonathan Ziegler

REPELLING AN INVASION

When plum pox virus was identified in Adams County, Pennsylvania peaches late in 1999, researchers and extension agents from Penn State's College of Agricultural Sciences swung into action. Working closely with colleagues from the U.S. Department of Agriculture and the Pennsylvania Department of Agriculture, these experts played an important role in defusing a potentially serious economic threat.

Plum pox is a devastating disease of stone fruits. Although it poses no danger to consumers, it can ruin the marketability of plums, peaches, and apricots, and severely curtail yields. Widespread in Europe, the virus was detected in Chile in 1992, but had never been seen in North America. The Adams County outbreak posed an immediate threat to Pennsylvania's $25 million-a-year stone fruit industry, and also to the nation's, valued at $1.8 billion.

The first step to corralling the disease was making growers aware of the danger, and the symptoms. A massive survey of orchards led to quarantines of affected areas. To eradicate the disease, infected and surrounding trees had to be destroyed.

At the same time research efforts were initiated to determine how plum pox spreads. Penn State plant pathologist John Halbrendt set up a lab at the University's fruit research and extension center in Biglerville to test weeds and other plant species as potential reservoirs of the disease. Viral epidemiologist Fred Gildow began experiments to determine which of dozens of aphid species was responsible for spreading it. Economists Jay Harper, Tim Kelsey, and Martin Shields contributed an impact analysis that helped convince the state legislature to reimburse farmers faced with losing their livelihoods.

The rapid response worked. After some 1,200 acres of stone fruit orchards were removed in Adams, Cumberland, and York counties in 2000 and 2001, levels of infection have dropped to almost nothing. Intensive surveys show no presence of the disease outside the limited outbreak area. Continued efforts are expected to eliminate plum pox from the U.S. over the next few years.

In 2002, the multi-agency team was officially recognized by U.S. Secretary of Agriculture Ann Veneman for effectively limiting the spread of plum pox "by building an inclusive team of university, state, federal, and agricultural industry personnel."

To learn more, see http://sharka.cas.psu.edu/.

Howard Nuernberger

LIONHEARTED

In November, Gayle Snider, a 36-year-old man from York, Pennsylvania, marked four months at home with his Arrow LionHeart™ — a totally implantable heart-assist device conceived of and developed at Penn State College of Medicine in conjunction with Arrow International of Reading. Snider, the first U.S. recipient of the device to be released from the hospital, celebrated with a trip to Dover International Speedway in Dover, Delaware to watch a NASCAR event.

In the same month, Penn State Hershey cardiologist John Boehmer presented the results of the first clinical trial of the device, which is powered by wireless electronic transmission. The study followed 23 patients in Europe from October 1999 to December 2002 and showed a low incidence of infection and only three device failures in 17.3 years of support time. "LionHeart has a lower infection rate than other heart-assist devices that require lines or cables protruding through the skin," said Walter Pae, Penn State Hershey professor of surgery and principal investigator for the European trial. "Because there is nothing through the skin, it also allows patients to detach from the power source for short periods to bathe or swim, improving their quality of life."

Based on the results of the European trial, Arrow International reported, it has received authorization to market the device within the European Economic Area as a "destination therapy," i.e., for permanent implantation. A U.S. trial of the device is currently underway.

The Arrow LionHeart — the first totally implantable left ventricular assist device capable of taking over the entire workload of the left ventricle — is intended as a long-term therapy for patients with end-stage heart failure who are not candidates for heart transplantation. Such patients make up the overwhelming majority of the 400,000 to 700,000 new cases of heart failure diagnosed in the U.S. each year.

Arrow International

The technology behind the Arrow LionHeart was developed by an interdisciplinary Penn State team led by professor of surgery and bioengineering Gerson Rosenberg, who was honored in 2002 as *Design News* Engineer of the Year.

To learn more, see http://pennstatelionheart.com.

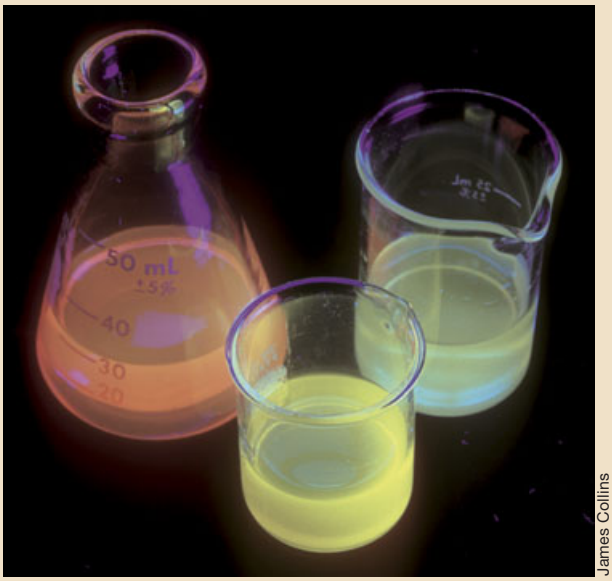
Nanoparticles

Imagine a sphere so small it would take 10,000 copies lined up to span the width of a human hair. Within its curved shell is a cavity filled with fluorescent dye. Inhaled or injected into the body, this tiny, glowing particle, tagged with a cell-specific label, attaches itself only to tumor cells or to white blood cells, effectively pinpointing a tumor or an infection.

Materials chemist Jim Adair and doctoral student Sarah Rouse, working with spectroscopist William White and biomedical engineer Christopher Siedlecki, are making these nanoscale composites at the Penn State Particulate Materials Center (PMC).

A National Science Foundation Industry/University Cooperative Research Center, the PMC's mission is to develop new and better ways of manufacturing and processing powders and other particulates used in industries ranging from protective coatings to cosmetics. In all of these industries, precise control of particle size, shape, chemistry, and dispersion in solution are vitally important. "The processes we develop have to be efficient, reliable, and simple enough to be easily adopted," says Adair, the Center's director. The fluorescent spheres, called nanocomposite particles, are an example of a growing focus on nanoparticulates, which Adair calls "the future, in both inorganic and biological applications."

Fluorescent labeling is a widely used technique for medical diagnostics and biological imaging. Fluorescent tracers are also used to track environmental contaminants. Today, tracers are typically made by attaching a protein tag onto a molecule of fluorescent dye. But to do so without destroying the molecule's ability to fluoresce, Adair says, "is a complicated problem of organic chemistry." Instead, he and Rouse found a way to create a composite particle using a self-assembly technique that causes silicon dioxide molecules to arrange themselves around an open core. "What you end up with is a core full of dye with a protective shell around it," Adair explains. "Attaching a label to that nice clean silica surface is chemically very easy."



James Collins

So easy, in fact, that the same core-shell technology could be useful for many different applications. One likely possibility, Adair says, is as a targeted delivery system for chemotherapy. "You could create a particle that will bind to cancer cells only, with a timed-release coating that would deliver the drug exactly where and when you want."

To learn more, see http://www.mri.psu.edu/centers/pmc/.

Keys to the Genome

The sequencing of the human genome, completed in 2000, was a landmark achievement in human history. But knowing the genome — that string of three billion base pairs, the entire directory of our genetic information — is only the beginning.

The great challenge for today's genomics researchers is to deduce which among the DNA sequences in that vast string are functional, and which sequence does what. One way to do that is by comparing DNA sequences, both within and between species. Such painstaking analysis, at such a scale, relies entirely on advances in bioinformatics, the combination of computer science and molecular biology. Researchers at Penn State's Center for Comparative Genomics and Bioinformatics, part of the Huck Institutes of the Life Sciences, are actively involved in developing the computational tools and databases that will be necessary.

One of these tools, known as BLAST, has been called the most frequently used program in biology. Developed by Webb Miller, professor of computer science and engineering at Penn State, along with colleagues at the National Center for Biotechnology Information and the University of Arizona, BLAST, for Basic Local Alignment Search Tool, is actually a suite of programs that allows for fast, accurate comparisons between sequences of DNA or proteins. The 1990 paper that described BLAST was the most cited research paper of the last decade. New versions of BLAST developed in Dr. Miller's group are now used to align the entire genomes of human, mouse and rat.

Another tool, ETOPE, developed by Penn State's Anton Nekrutenko with colleagues at the University of Chicago, uses aligned sequences of human and mouse DNA to find DNA segments likely to code for proteins. Other programs find candidates for sequences controlling the time and level of gene expression. GALA, developed by Miller and Ross Hardison, director of the Penn State Center, is a database that includes annotated versions of the human, mouse and rat genomes, incorporating up-to-date information about genes, mutations, and associated functions, and sequence conservation.

The computational predictions that these tools produce are now being tested experimentally in laboratories at Penn State and elsewhere, Hardison notes. Using computational predictions to develop hypotheses to test in the laboratory, while a familiar approach for physicists and chemists, is a new paradigm for biology, he adds. Penn State is taking a lead role in this paradigm shift.


Steve Miller

To learn more, see http://www.bx.psu.edu/miller_lab/.

Technology Transfer

For faculty and students at Penn State, the opportunity to do relevant and commercially useful research is an important component of the educational experience, and fulfills a central mission of the University to serve the people of the Commonwealth. Through the integrated efforts of the seven Technology Transfer units, federal, state and industry funds are transformed into benefits for all. These seven units cover every aspect of the commercialization process, from linking industrial research sponsors with faculty; to patenting and licensing; to assisting start-ups with incubation and advice; to providing financing, counseling, and technical assistance for small companies and convenient physical facilities for companies of all sizes at the expanding Innovation Park.

New technologies researched and licensed in FY 2003 spanned the breadth of Penn State's expertise, including a calf management training system for dairy farming, low temperature crystallization of amorphous silicon films, computer-decision models for implementing marketing tactics and strategies, new treatments for malignant diseases including leukemia, surgical simulation software, and human applications of a gel drug-delivery system.

Economic development efforts supported non-university companies in every county in the Commonwealth, in diverse industries including auto salvage, cell phone and laptop high-gain antennas, flame retardant coatings, food processing, website and e-business up-grading, powdered metals, tool making, distributed power generation, environmental compliance, lumber, and factory-built housing.

To learn more, see http://www.techtransfer.psu. edu/.

Intellectual Property Office

The Intellectual Property Office manages all intellectual property developed at Penn State, assessing the commercial potential of approximately 200 University inventions per year, formulating and implementing patent and marketing strategies, and negotiating license agreements. The U.S. Patent and Trademark Office ranked Penn State ninth among all U. S. universities in the number of patents issued in 2002.

Penn State continues to accept equity positions in start-up companies through license agreements. Since 1999, Penn State has executed a total of 23 equity-based licenses.

Penn State's technological strength as measured by the number of patents issued and the number of times they are cited increased Penn State's ranking from 31st in 1997 to 14th in 2002 among all U.S. universities according to data reported in MIT's *Technology Review.*

FY 2003

Invention Disclosures	163
U. S. Patent Applications	167
Issued Patents	71
Revenues	$3.1 million
Cumulative Equity Held	23

NOTE: Not included in revenue is the equity Penn State holds in start-up and established companies.

Research Commercialization Office

The RCO helps Penn State faculty and staff create new companies based on University research and technologies. It works closely with Penn State's Intellectual Property Office. The RCO can identify and secure sources of early stage capital such as seed funding programs, angel investors, venture capital funds, etc., as well as mentors and potential management-team members. Space for start-up companies is available in the Innovation Park at Penn State and in the Penn State Zetachron Center for Science and Technology Business Development, a gift of Dr. and Mrs. Wally Snipes and family.

The Penn State-related companies currently in the incubation process are ChiralQuest, Inc., Accelerated Product Developent, Inc., Fluent Cardiovascular Solutions, IQS Research & Development, Thermolose, NanoHorizons, Sentech, Sentechbiomed, DIApedia, QuantumBio, BlueSwarf, Chromotography Associates, LCM, Inc., Dynamic Floor Systems, Verifi, American Analytical, Sinoceramics, and DecisionPro.

Recent graduates are Mitotyping Technologies, EIEICO, Centre Ingredient Technologies, Keystone Food Science, Salimetrics, and Advanced Interfaces, Inc.

Industrial Research Office

Penn State ranks third nationally in industrially-sponsored research funding. With $545 million in total research expenditures and over 2,500 science and technology based researchers, the University is a vast repository of expertise, technology, and facilities. The Industrial Research Office facilitates the connection of businesses to Penn State researchers to pursue collaborations and external funding opportunities.

Our team of industry-experienced liaisons works to understand the varied needs and interests of our clients, from small start-up companies to large multi-national organizations, and to transfer that knowledge to our researchers and develop linkages that lead to mutually beneficial long-term relationships. During FY 2003, IRO facilitated industry-sponsored research generated by 43 companies, totaling $6.4 million.

Pennsylvania Technical Assistance Program

PENNTAP helps Pennsylvania companies improve their competitiveness by providing a limited amount of technology assistance and information to help resolve specific technical questions or needs. The program focuses on helping smaller firms that normally do not have in-house expertise or resources. A network of PENNTAP technical specialists located throughout the state assists these small companies by providing advice, information, and connections to other expertise, resources or programs.

Formed in 1965, PENNTAP is a federal-state-university partnership for economic development, and one of the nation's first technical assistance programs. It remains a credible and valuable resource for helping Pennsylvania companies compete and grow.

FY 2002	FY 2003
Cases of Technical Assistance	
480	810
Clients Reported:	
Jobs Created or Saved	
355	670
Economic Benefits	
$8.3 million	$24.0 million
Satisfaction	
98%	100%

Ben Franklin Technology Center of Central and Northern Pennsylvania

The BFTC of Central and Northern Pennsylvania provides financial support, technology and management experience, and ways to link public, private, and educational resources to strengthen the high technology components of the state's economy. It is one of four regional centers of the Commonwealth's Ben Franklin Technology Development Authority.

For FY 2003, 38 research projects were funded with over $3.83 million in Ben Franklin funds and $10.27 million in private-sector cash and in-kind funds.

Small Business Development Center

The Penn State SBDC is part of a national network of more than 950 centers, 16 of which are based at colleges and universities in the Commonwealth, whose mission is to provide business training and consulting to existing and prospective business owners.

The Penn State SBDC provides consulting assistance to small business owners in Centre and Mifflin counties. In addition, the Center's two Environmental Management Assistance Program (EMAP) specialists, one at University Park and one at the Wilkes-Barre campus, provide environmental-management assistance to small business owners in 19 counties in central Pennsylvania and 13 counties in the northeastern region of the state.

During the past year, Penn State SBDC staff provided over 4,000 hours of consulting assistance. MBA candidates working as part-time SBDC consultants and undergraduate students conducting environmental research and site visits, designing corporate identities, and developing other marketing materials contributed more than 1,448 hours of assistance to SBDC and EMAP clients. The Penn State SBDC conducted 52 training seminars and assisted 284 small-business clients, tracking investments of $2.9 million.

Chiral Quest goes public

In February 2003, company officials announced the merger of Chiral Quest, LLC, and Surg II, Inc. to form Chiral Quest, Inc., a public company trading on the OTC Bulletin Board under the symbol "CQST.OB." The announcement reflected a Penn State milestone: "Chiral Quest is the first University faculty start-up company to go public," said Gary Weber, associate vice president for research and director of technology transfer.

Chiral Quest's technology is based on the discoveries of Penn State chemist Xumu Zhang in the area of chiral chemistry. Chiral chemicals exist in two forms, one the mirror image of the other, like a right hand and a left hand. Over one-third of all drugs now on the market are chiral drugs, which means that of their two forms one is good, the other is often ineffective or even dangerous. Zhang has developed asymmetric catalysts to synthesize only the preferred form of such chiral compounds. Several families of his catalysts, consisting of multiple invention disclosures and patent applications, were licensed in October 2000 to Chiral Quest LLC, a start-up company in State College, Pennsylvania.

The newly public Chiral Quest, Inc., offers an array of catalysis products and technology, including the Chiral Toolbox™, which are designed to facilitate the development of chiral molecules. These products are protected under patents held by the Penn State Research Foundation, which also retains equity ownership in Chiral Quest.

Soon after going public, the new company announced the appointment of Nobel laureate K. Barry Sharpless, W.M. Keck professor of chemistry at the The Scripps Research Institute, as chairman of its scientific advisory board. Last June, Chiral Quest opened a laboratory facility in Princeton, New Jersey, to complement its existing facility in State College, and to provide enhanced production capacity. Chiral Quest technology is being marketed to pharmaceutical and chemical companies around the world. Its current capitalization approaches $20 million.

To learn more, see http://www.chiralquest.com/.

Healthy Economy

James Collins

An independent study released last September shows that Penn State's Hershey campus — including Penn State College of Medicine and Penn State Milton S. Hershey Medical Center — is a major economic engine for both south central Pennsylvania and the entire state. The study, conducted by the Pittsburgh-based Tripp Umbach Healthcare Consulting, Inc., determined that the statewide economic impact of Penn State Hershey in 2002 was $613 million, and that the campus generated 13,500 Pennsylvania jobs.

"In measuring the overall impact of Penn State Hershey, we found it to be an important contributor to both the physical and economic health of Pennsylvania," said Paul Umbach, who produced the report. Against approximately $4.7 million in unrestricted state funding received in 2002 for medical education, Penn State Hershey generated more than $34.8 million in total state tax revenue, a return of $7.40 on the dollar. According to Tripp Umbach, the average U.S. medical school returns $1.45 for every dollar received from its home state.

The report also shows that Penn State Hershey attracts more than $40 million to the state just from federal sources for its research activities. In 2002, more than $30 million of this support remained in the state's economy, generating $65 million in economic expansion and more than 2,300 Pennsylvania jobs.

Penn State Hershey's statewide impact has grown dramatically, from $404 million in 1995 to $613 million in 2002, and is projected to reach $914 million by 2008 as a major facilities expansion is completed. That impact should translate to 20,000 total jobs.

In May 2003, Penn State Hershey was a major sponsor of and participant in Innoventure 2003, a two-day science and research expo held at the Hershey Lodge and Convention Center. Over 130 scientific and commercial exhibitors presented highlights of cutting-edge work being done in the life and health sciences in central Pennsylvania. Exhibits covered a wide range of topics, from new therapies for melanoma skin cancer to heat-stable enzymes for catalyzing industrial reactions.

The event attracted a host of sponsors including the Ben Franklin Technology Partners, the Hershey Foods Corporation, the Life Sciences Greenhouse of Central Pennsylvania, and the Technology Council of Central Pennsylvania.

"Research and technology are the key to an economy that will lead to better health, lower healthcare costs, and substantial economic growth," said Jay Moskowitz, Penn State associate vice president for health sciences research and chairman of the event. "The central Pennsylvania region is poised to be a leader in this arena."

To learn more, see http://pennstatehershey.com.

Small Business Boosters

Penn State's Pennsylvania Technical Assistance Program (PENNTAP), dedicated to helping Pennsylvania businesses improve their competitiveness, won two 2003 outstanding project of the year awards from the National Association of Management and Technical Assistance Centers (NAMTAC).

Mark D. Toda, PENNTAP's senior technical specialist in northeastern Pennsylvania, was cited for the best project in NAMTAC's Business Assistance category. Toda helped Cornell Iron Works of Mountaintop, a leading manufacturer of rolling doors, come up with a more efficient process for developing new products. After implementing the new process, Cornell Iron Works reported $2 million in increased sales and the creation of five new jobs.

John Pletcher, PENNTAP forest products specialist, helped Nature's Blend Wood Products, a cabinet-door manufacturer in Ford City, use a computer simulation of its milling operation to justify the purchase of a new gangsaw that increased yield of product from raw material by 10% and saved $124,000 the first year in material and labor. Pletcher's subsequent analysis showed that by adopting minor process changes and redirecting scrap into usable products the company could save an additional $157,000 per year. Pletcher's work was honored as best in NAMTAC's Technology Transfer category.

In 2002, PENNTAP's e-business assistance program, e-TAP, developed to help the state's small businesses with their Internet, website, and information technology needs, completed 340 cases of technical assistance and provided $6.8 million in economic benefits. A new effort aimed at helping the state's food-processing industry with needs related to food chemistry and safety, shelf life, quality control, packaging and other issues completed 45 cases of technical assistance and provided $2.3 million in benefits.

Howard Nuernberger

Harnessing Light

From the remote-control clicker that runs your TV to the surgical laser that splices a ligament or slices out a tumor to the liquid crystal display in your computer, optical technologies — based on the generation and control of light — are all around us. In addition to being increasingly important in daily life, electro-optics are also the basis for imaging, weapons, and communications technologies that impact our national defense.

The Electro-Optics Center was established in 1999 as a part of Penn State's Applied Research Laboratory to support the growth of this rapidly evolving field. Created as an initiative of the Office of Naval Research, the EOC has as its mission to improve the technology and reduce the costs of electro-optical manufacturing through applied research, technology transfer, and workforce education.

Currently located in a 22,500 square-foot facility in the West Hills Industrial Park near Kittanning, Pennsylvania, the EOC contains laboratory and classroom space, and a "teaching factory" for the development of prototypes and processes. Last August, U.S. Rep. John P. Murtha (D-PA), who has played a lead role in bringing the Center to southwestern Pennsylvania, unveiled plans for an expanded, 45,000-square-foot facility in Armstrong County that will serve as the EOC's permanent home.

The Center's research is organized in four core areas: fiber optics, lasers, materials, and night vision/infrared technologies. Some of the technology enabled by the EOC, particularly in the area of night vision, has been used in the recent conflicts in both Afghanistan and Iraq. The Center has also developed educational programs for both K-12 and adult audiences to address a growing shortage of workers adequately trained in electro-optics technology.

Courtesy EOC

Finally, the EOC has established the Electro-Optics Alliance to assist technology transfer to industry, and to promote U.S. preeminence in the field. The EOA currently has 223 members: 178 industrial, 36 academic, and 9 government affiliates.

Over the last four years the existence of the Center has played a role in drawing at least nine new electro-optics-related companies to western Pennsylvania and has helped to generate almost 200 new jobs. "Electro-optics is a rapidly growing industry, and we're positioning ourselves to be an international center," Rep. Murtha said recently. "As the Electro-Optics Center grows, I think it'll become even more of a magnet to attract more companies and jobs to western Pennsylvania."

To learn more, see http://www.electro-optics.org/.

Tuned In

Ever lose the signal in the middle of a cell-phone conversation? Thad Will is tired of that all-too-common occurrence. That's one of the things that drives his interest in finding a market for a new antenna technology that could revolutionize wireless communication. Will and three other MBA students from Penn State's Smeal College of Business Administration — Jonathan Butz, Krishna Patel, and Sean Raynak — developed a business plan for the new antenna that was good enough to win $35,000 in a contest sponsored by Ben Franklin Technology Partners last June.

The students undertook the project as part of the MBA program's entrepreneurship component. Tony Warren, executive director of Smeal's Farrell Center for Corporate Innovation and Entrepreneurship, matched them with the inventors of the device, professors Tom Jackson and Doug Werner of Penn State's College of Engineering.

Today's ferrite antennas, Will explains, are based on a decades-old technology that is increasingly insufficient for the growing demands of wireless communication. A ferrite antenna sends a signal out in all directions, and when it finds a source translates the return signal into reception. This approach is much less efficient than an antenna that is tuned directly to its source, like a satellite dish. Jackson and Werner, Will says, "have developed a technology that builds on the directional idea. An antenna that is constantly retuning itself."

The prototype for the new device looks like a small square cut from a lap-top computer screen. It uses pixelized display to transmit radio signals accurately and efficiently, requiring less battery power than a standard antenna and increasing gain reception three- to six-fold, according to preliminary tests. It could eventually be shrunk to the size of a postage stamp, small enough to fit easily on the back of a cell phone or a Palm Pilot.

Will and his partners submitted a business plan based on the invention to the Ben Franklin contest, which aims to boost Pennsylvania's economy by promoting entrepreneurship and technological innovation. Winning the $35,000 award has allowed them to proceed with an intellectual property search and subsequent patent filings.

FrontaLobe, the company they formed, is now incorporated and has signed an exclusive licensing agreement with Penn State. "Right now we're awaiting the results of prototype testing before we can go out and attract some investors," Will reports.

FrontaLobe

Innovation Park

Innovation Park at Penn State was adopted by the University's Board of Trustees in 1987 as a phased-development project to assist in the economic revitalization of the Commonwealth. Located adjacent to Penn State's University Park campus at the interchange of I-99 and U.S. Route 322, Innovation Park is 118 acres designated for business development, including incubating start-up companies through mature corporations, as well as amenities to support businesses and their employees. The mission of Innovation Park at Penn State is to provide space, access to University researchers and facilities, and business-support services that help companies transfer the knowledge within the University to the marketplace and to foster economic development.

During FY 2003, Innovation Park hosted 41 tenants, incuding 12 in the business incubator. In addition to consulting with Penn State faculty, park tenants used 96 Penn State undergraduate interns and 92 graduate students, and hired 25 Penn State alumni. Four tenants were companies based on licensed Penn State intellectual property.

Construction continues on three building projects approved in FY 2002, including construction of an Innovation Outreach Building and a privately developed multi-tenant building, and an expansion of the Penn Stater Conference Center Hotel.

The Innovation Outreach Building, which will house both Penn State Public Broadcasting and the World Campus, Penn State's web-based distance education program, will be complete in early 2005.

The multi-tenant building, a 75,000 square foot privately developed facility at 328 Innovation Boulevard, will be complete in early fall of 2004, the first building to be constructed in Phase 3 of Innovation Park. Several tenants have already signed leases for space in the building. This project also includes an improvement of infrastructure and extension of the boulevard necessary for Phase 3. In partnership with the Chamber of Business of Centre County, Innovation Park secured grant funds from the Appalachian Regional Commission and the Pennsylvania Infrastructure Development Program to assist with these improvements. The road extension will be complete in early fall of 2004 and will provide four additional construction-ready building sites.

The Penn Stater Conference Center Hotel construction will be complete in July 2004, with an additional 150 guest rooms being added to the facility.

A fourth project, expansion of the Technology Center, is now complete and several new start-up companies moved into the facility as tenants in January. This project was undertaken in partnership with the Life Sciences Greenhouse of Central Pennsylvania, which provided grant money for the addition of 2,000 square-feet of wet-lab space intended to provide space for incubating life science companies in the Centre region.

Innovation Park has joined a partnership with the economic development offices of Bedford, Blair and Centre counties to market the I-99 Innovation Corridor. With construction of the I-99 highway improvements, the regional marketing effort is designed to highlight the benefits and opportunities of locating business adjacent to the research and technology resources available at Penn State.

To learn more, see http://www.innovationpark.psu.edu/.

Courtesy Innovation Park at Penn State

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